Official Authorized to Bind this Proposal:

Name: _____

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Technical Proposal

Creating a Statewide Spatially and Temporally Allocated Wildfire and Prescribed Burn Emission Inventory Using Consistent Emission Factors

Solicited Proposal Prepared for:
State of California Air Resources Board
Research Division
P.O. Box 2815
Sacramento, CA 95812

April 13, 1999

by :
Peng Gong, Principal Investigator
Rick Standiford, Co-PI
John Radke, Co-PI

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Contract Budget: $163,997

Creating a Statewide Spatially and Temporally Allocated Wildfire and Prescribed Burn Emission Inventory Using Consistent Emission Factors

Background

For many regions in California, wildfire and prescribed forest burning emissions are significant contributors to episodic $PM_{2.5}$ and visibility reducing particles. Federal and state land managers have plans to increase the levels of prescribed burning within California to improve forest health. Smoke from this burning can have significant health impacts on exposed populations if not properly managed. Because of these public health impacts and the need to maintain ecosystem health through burning, there is an increasing need for better estimates of fire emission estimates and fire modeling (Sandberg et al. 1999). This information can be used to better determine air quality impacts and to refine burning policies.

The existing California Air Resources Board's (ARB's) emission estimates for wild fire and managed forest burning must be improved for $PM_{2.5}$ SIP planning and visibility impact assessment. Current estimates lack (1) well coordinated research on emission factor estimation, (2) a consistent way of mapping vegetation, and (3) spatial and temporal knowledge on each fire including the location, actual acreage and duration of burning (Sandberg et al. 1999). Using GIS, remote sensing, and other land coverage data and fuel specific emission factors, this project will produce emission estimates based on historical burning acreage, burn locations, and location specific fuels data for wildfires and prescribed wildlands burning. The emissions will be provided by season, and will include projections of future emissions (both as mass and spatially).

Purpose

The purpose of this project is to develop a method for producing coherent, consistent, spatially and temporally resolved GIS based emission estimates for wildfire and prescribed burning. This method will be tested and validated for several California regions. If sufficient resources are available within the contract funding and adequate input data are available, the method will be applied on a statewide basis. This project will coordinate with the air districts, land managers, and ARB staff to produce a consistent, up-to-date emission inventory using current fuel loading land coverages, the most recent emission factor data, consistent methodologies, and temporally and spatially resolved GIS based emission estimates.

Tasks and Methods

Task 1. Compilation of emission factor data and land-cover data. We will make a comprehensive literature search (such as Delmas et al. (1995) for tropical areas) and contacts with forest burning experts to collect emission factor data available for forest biomass burning. Emissions for PM_{10} and $PM_{2.5}$ are of the highest priority, but total organic gas (TOG) and other pollutants will also be compiled. We will conduct interviews of forest burning experts in Sacramento, California; Missoula, Montana; Seattle, Washington; and Washington DC.

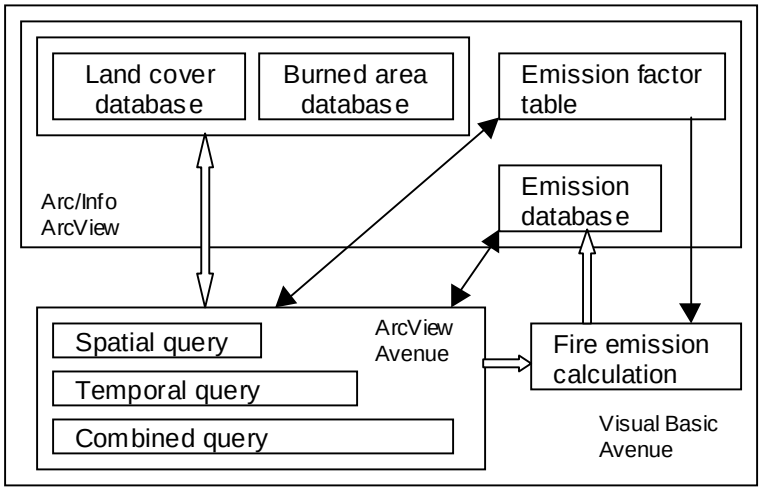
In addition, we will identify appropriate land use, vegetation coverages (such as the GAP data (Davis et al. 1998), California's hardwood database (Pillsbury et al. 1991), and the large area forest change detection database by USFS Forest Pest Management Program and California Department of Forestry and Fire Protection (Levien et al. 1997)), and other electronic map data which can assist in the assignment of emission factors to the underlying areas burned. Results of this first phase will be a compilation of emission factors and recommendations for which data are the most reasonable and applicable for use in California. With ARB coordination, results of this phase will be evaluated and approved by land managers, ARB staff, and air district staff.

Task 2. Developing temporal GIS databases of fires. This phase will include contacting land managers and other sources of data to gather historical, current, and projected estimates of wildfire and prescribed burns. Emphasis should be placed on collecting data that can be readily included in GIS based data systems. Develop database of burns and burn parameters such as date, duration, acres burned, location, and type of burn. We will begin the development of wildfire and prescribed fire database at one or several selected areas within California in consultation with ARB staff and expand statewide if time and resources allow.

In the meantime, we will collect Landsat Thematic Mapper (TM) imagery corresponding to the selected areas and daily NOAA AVHRR imagery during the fire season for a specific year. Data collection criteria will be established in consultation with ARB staff. We will use the remotely sensed data for two purposes: (1) conduct fire detection using image classification algorithms developed by us (Gong, 1996) particularly with Landsat TM data and the algorithm developed for AVHRR data by Li et al. (1999), and (2) estimate fire emissions using the algorithms developed by Kaufman et al. (1990) and Ferrare et al. (1990). The results of this phase include temporal GIS databases of fires in selected areas of California and a temporal GIS database of fires for the entire State of California with a resolution of 1 km X 1 km from NOAA AVHRR data.

Task 3. Emission estimation model development. We will collect the most applicable land coverage data identified in Phase 1. We will compile land cover data sets if they will be helpful to improve the temporal precision (i.e., temporal resolution such as fire data are recorded on weekly or daily basis) of the data. Since a land cover data set made from a relatively recent (say 1998) data sources is not useful for emission estimation of relatively old (say 1996) fires as the fuel types would be labeled as burned area, there

should be adequate time correspondence between fire occurrence and land cover map. When necessary, we will use various remote sensing image processing software such as PCI EASI/PACE and ERMAPPER to pre-process and classify remotely sensed data for land cover data preparation. Various land cover data sets will be processed using Arc/Info GIS software system and stored in ArcView file format for emission estimation.
The wildfire and prescribed burn emission estimation system (EES) should include components in the following flow diagram:



Boxed text - components; unboxed text - programming environment

The land cover database in the EES could contain several layers with different levels of detail or made from data sources collected at different times. We have the burned area database from task 2. It includes burned area and at least the starting date, duration and type of the fire for each burned area as the additional information. The emission factor table in the EES is obtained from task 1 and stored in ArcView format. It can be edited and queried for emission estimation. The emission calculation part in the EES will be designed to have some intelligence on top of the emission calculation. It will incorporate various rules regarding the data usage. For example, when the queried time interval for an area is the summer season while the duration of some fires in that area extended beyond the end of June. Certain interpolation in time will be applied when calculating the fire emission. Each land cover type has a limited amount of biomass for burning. Another example is due to the fact that the duration for fire at any particular location in a burned area only last for a limited period in time for a given type of fire (and weather conditions). This will be taken into account in emission estimations.

The EES will be designed to have the capability to produce 1-year estimates, an estimate of multiyear average annual emissions (provided input data are available), and future projected emissions based on a scaling factor applied to existing data. In addition to maps, tabular data will also be provided using the EES showing separately reported listings of prescribed and wildfire emissions subdivided by county.

With the support of ArcView and Avenue, spatial queries can be made based on additional data layers such as the county and air basin boundaries. Such data will be collected and prepared for information retrieval from the EES. Spatial and temporal queries and modifications in the EES can be made to the land cover and burned area databases. It is also possible to query and edit the emission database derived from the emission calculation. A user-friendly interface will be designed and built using scripts in Avenue and the Visual Basic programming language.

We will begin with the design, implementation and testing of the EES in a specific geographical region (such as a county, a national park, or other region) in consultation with ARB staff. Attention will be placed on attempting to include information on the typical time of the year burns occur in different regions in the state.

The result of this phase is a fully functioning, user-friendly emission estimation system for prescribed burn and wildfire estimates. The limitation of the system will primarily be limited by the quality of the databases and emission factors.

Task 4. Production of gridded emission estimates. We will rasterize the land cover and burned area layers to 4 km X 4 km cell size. This will be achieved with Arc/Info. While the methodologies developed in Phase 3 is applicable to the gridded datasets, the number of layers to be handled will be too many for ArcView. The grid data structure requires a different organization of the data. Instead of holding either the land cover data or the burned area in one master file as in the EES, those input files, particularly for the burned area dataset, will be better decomposed into many layers. For the burned area dataset, it is better to make each layer record the burned area in the minimum time interval used (such as a day or a week). With such a data structure and organization, the query and computation is very efficient. This can be most efficiently done in a raster GIS or even better in some image processing packages with GIS functionality. We will implement the algorithms in PCI EASI/PACE. The result of this phase will be a software system similar to EES but can produce independent gridded estimates of prescribed burn and wildfire estimates.

Task 5. Preparation of draft and final reports. The report will include the current best estimate of gridded, statewide estimates for wildfire and prescribed burning. It will include descriptions on the data and methodologies used, documentation of algorithms used for emission estimates, the information acquired in Task 1, and the electronic files providing the gridded emissions and the underlying coding used to produce the emission estimates. The report will include a discussion of the limitations of the data provided and recommendations for future improvements.

Project Schedule

Project Duration is16 months
(June 15, 1999 to October 31, 2000)

June 15, 1999. Project starts with Tasks 1, 2 & 3.

October 31, 1999. (month 4) Task 1 complete, Tasks 2 & 3 ongoing.

February 28, 2000. (month 8) Task 2 complete, Task 3 ongoing

June 30, 2000. (month 12) Task 3 complete, Task 4 & 5 start.

August 31, 2000 (month 14) Task 4 complete, Draft final report ready for ARB review.

September 30, 2000 (month 15) Receive ARB comments on draft report.

October 31, 2000 (month 16) Task 5 complete and submit the final project report.

References

Davis, F. W., D. M. Stoms, A. D. Hollander, K. A. Thomas, P. A. Stine, D. Odion, M. I. Borchert, J. H. Thorne, M. V. Gray, R. E. Walker, K. Warner, and J. Graae. 1998. The California Gap Analysis Project--Final Report. University of California, Santa Barbara, CA. [http://www.biogeog.ucsb.edu/projects/gap/gap_rep.html]

Delmas R, LaCaux JP, Brocard D, 1995. Determination of biomass burning emission factors: methods and results, *Environmental Monitoring and Assessment*, 38:181-204.

Ferrare RA, Fraser RA, Kaufman YJ, 1990. Satellite measurements of large-scale air pollution measurements of forest fire smoke, *JGR*, 95(D7):9911-9925.

Flasse SP, Ceccato P., 1996. A contextual algorithm for AVHRR fire detection. *International Journal of Remote Sensing*, 17(2):419-424.

Gong, P., 1996. Integrated analysis of spatial data from multiple sources: using evidential reasoning and artificial neural network techniques for geological mapping. *Photogrammetric Engineering & Remote Sensing*, 62(5):513-523.

Kaufman YJ, Tucker CJ, Fung I, 1990. Remote sensing of biomass burning in the tropics, *JRG*, 95(D7):9927-9939.

Kennedy PJ, Belward AS, Gregoire J-M, 1994. An improved approach to fire monitoring in West Africa using AVHRR data. *International Journal of Remote Sensing*, 15(11):2235-2255.

Levien LM, Bell CL, Maurizi BA, 1997. Large area change detection using satellite imagery: southern Sierra change detection project. Newsletter of the Integrated Hardwood Range Management Program, *Oaks 'n' Folks*, 12(1).

Li Z, Nadon S., Cihlar J., 1999. Satellite detection of Canadian boreal forest fires Part I: algorithm development and application, *International Journal of Remote Sensing*, in press.

Miranda AI, Coutinho M, Borrego C, 1994. Forest fire emission in portugal: a contribution to global warming? *Environmental Pollution*, 83:121-123.

Pillsbury NH, De Lasaux MJ, Pryor RD, Bremer W, 1991. *Mapping and GIS Database Development for California's Hardwood Resources*, Contract Report, Forest and Rangeland Resources Assessment Program, California Department of Forestry and Fire Protection, Sacramento, CA, 62p.

Sandberg, D., Hardy CC, Ottmar RD, Snell JAK, Acheson AL, Peterson JL, Seamon P, Lahm P, Wade D, 1999, *National Strategic Plan: Modeling and Data Systems for Wildfire and Air Quality*, General Technical Report PNW-GTR-450, Pacific Northwest Research Station, USDA Forest Service.

Centers Involved

CAMFER: The Center for Assessment and Monitoring of Forest and Environmental Resources (CAMFER) at University of California, Berkeley, is established in 1995 in the College of Natural Resources. Its mission is:

> *To bring together a group of world-class scientists and researchers to develop and apply innovative spatial information techniques to improve our capability in modeling forest and other ecosystems for making better policies and decisions about the world's natural resources and environment*.

In 1998, it received an award from the Regional Center of Excellence in Remote Sensing Applications Program of NASA. It has also been supported by the Geographic Information Science Center at University of California at Berkeley. CAMFER is equipped with modern technologies of computer, imaging, and global positioning facilities. This includes first-class networked computing facilities comprised of a SUN Enterprise 450 server and a 540 GB RAID storage system, a DEC Alpha file and computing server, and numerous high-end UNIX workstations from SUN, SGI and DEC, and a variety of digitizers, scanners, and color printers. CAMFER maintains a large software library for digital image analysis, statistical analysis, and geographic data analysis. This includes: Splus®, SAS®, ARC/INFO®, ArcView®, ER Mapper®, PCI Easi/Pace®, VirtuoZo® and Oracle®. CAMFER owns two high-resolution digital CCD cameras, a portable hyperspectral radiometer, several Trimble and Ashtech GPS receivers with geodetic quality, ultrasonic transponder-digital distance measuring device, data recorders, a survey laser instrument and all other instrumentation needed to conduct the intensive inventory and mapping projects.

In the past few years, CAMFER researchers have carried out projects ranging from large area land cover mapping using NOAA AVHRR satellite data, establishing a new field called photo-ecometrics for forest inventory purposes, wildlife habitat mapping and wildlife population prediction, hardwood range land monitoring and change detection using various GIS, GPS and remote sensing techniques.

Center of Forestry: The Center for Forestry coordinates research, extension, and public service on forestry-related issues throughout the Berkeley Campus, and within the system wide Division of Agriculture and Natural Resources (DANR). The general mission of the Center is to:

> *Sustain forest land systems through scientific inquiry of: forest ecosystem processes; human interaction and value systems; and management systems and silvicultural practices.*

The Center for Forestry is committed to developing interdisciplinary research teams composed of campus faculty, CE specialists and advisors, and others to address important topics that advance scientific knowledge of forestland systems. Center for Forestry research teams bring together scientists from biological, physical, and social sciences to

study complex interrelationships on forest lands, integrating ecosystem processes and human institutions and values.

The Center is also involved in science-based outreach, public education, and policy analysis. This extension program is comprised of: focused symposia, statewide and localized workshops and field tours, professional continuing education, specialized curriculum materials, and public policy analysis.

Resumes of Primary Project Personnel

Peng Gong

151 Mulford Hall
Department of Environmental Science, Policy, and Management
University of California at Berkeley
Berkeley, Ca 94720-3110

Peng Gong is Associate Professor of remote sensing and GIS and Director for the Center for Assessment and Monitoring of Forest and Environmental Resources at the University of California at Berkeley. Before 1994, he taught in the Department of Geomatics Engineering at The University of Calgary, Canada. His research interest is in photo-ecometrics, land-cover and land-use classification, change detection, integrated analysis of multisource data and knowledge-based geographic information systems, and GIS in endemic disease control. He is the author/coauthor of over 120 technical papers, a winner of three best paper awards from the ASPRS, the Chief Editor for *Geographic Information Sciences*, editor for *International Journal of Remote Sensing*, an invited chapter editor for *Manual of Remote Sensing*, 3rd Edition, the editor for *"Urban Geographic Information Systems: Methods and Applications"*, the senior author of two books entitled *"Earth Observation Technologies and Earth System Science"* and *"The Sptaio-Temporal Dynamics of Land Cover and Land Use: Measurements and Assessment"* and the co-author of *"Practical GIS"* all published by Science Press of China.

EDUCATION

Ph.D., Geography, University of Waterloo, Waterloo, Canada 1990
M.Sc., Geography, Nanjing University, Nanjing, China, 1986
B.Sc., Geography, Nanjing University, Nanjing, China, 1984

AWARDS/SERVICES

1993	ASPRS 1993 ERDAS Award for Best Scientific Paper in Remote Sensing
1993	The John I. Davidson ASPRS President's Award for Practical Papers
1994	V Talbert Abrams Grand Award from ASPRS for Best Paper in Photogrammetry
1994-7	Adjunct Professor, The University of Calgary, Nanjing University
1994-	Guest Professor, Beijing Normal University, Wuhan University, and Chinese Academy of Sciences
1998	National Outstanding Overseas Scientists Award (Total 30 Awards), P.R. China

Director Center for Assessment and Monitoring of Forest and Environmental Resources
Editor-in-Chief *Geographic Information Sciences*
Editor *International Journal of Remote Sensing*
Reviewer for 11 international journals

EMPLOYMENT

1997 -	Associate Professor, 1994-97 Assistant Professor, Department of Environmental Science, Policy, and Management University of California at Berkeley
1991 - 94	Assistant Professor, Department of Geomatics Engineering, Calgary, Alberta
1990 - 91	Project Scientist, Earth-Observations Laboratory, ISTS, North York, Ontario, Canada

COURSES TAUGHT

At The University of Calgary (between 1991-1994)

- Engineering 313 Computer Graphics /Biology 509 Remote Sensing for Forest Ecology (Summer Course) /Geomatics Engineering 451 Principles of Geographic Information Systems /Geomatics Engineering 555 Remote Sensing and Image Analysis /Geomatics Engineering 515 Operations Research /Geomatics Engineering 637 Digital Image Rectification and Multisource Data Analysis /Geomatics Engineering 655 Digital Image Processing and Pattern Recognition

At the University of California at Berkeley (between 1994 until now)

- ESPM 101C Forest Mensuration, Surveying, and Photo Interpretation (Summer Campus)
- ESPM 172 Photogrammetry and Remote Sensing
- ESPM 198 Introduction to GIS and Mapping
- ESPM 271 Advanced Remote Sensing of Natural Resources
- ESPM 275 Advanced GIS for Natural Resource Studies

10 Selected Publications (from 46 refereed journal articles)

Gong, P., D. Wang, and S. Liang, 1999. Inverting a canopy reflectance model using an artificial neural network. *International Journal of Remote Sensing*. 21(1):111-122.

Yu, B., M. Ostland, P. Gong, R. Pu, 1999. Penalized linear discriminant analysis for conifer species recognition, *IEEE Transactions on Geoscience and Remote Sensing*.

Spear, R., P. Gong , E. Seto, B. Xu, Y. Zhou, D. Maszle, S. Liang, X. Gu, 1998. GIS and remote sensing for schistosomiasis control in Sichuan, China, *Geographic Information Sciences*, 4(1-2): 14-22.

Gong, P., R. Pu, and B. Yu, 1998. Effects of data transformation, band width and seasonality on conifer species recognition. *Journal of Remote Sensing*. 2(3):211-217.

Gong, P., R. Pu, B. Yu, 1997. Conifer species recognition: exploratory analysis of *in situ* hyperspectral data. *Remote Sensing of Environment*. 62:189-200.

Gong, P., 1996. Integrated analysis of spatial data from multiple sources: using evidential reasoning and an artificial neural network for geological mapping, *Photogrammetric Engineering and Remote Sensing* 62(5): 513-523.

Gong, P., R. Pu, and J.R. Miller, 1995. Coniferous forest leaf area index estimation along a transect in Oregon using Compact Airborne Spectrographic Imager data. *Photogrammetric Engineering and Remote Sensing*, 61(9):1107-1117.

Gong, P., J.R.Miller, and M. Spanner, 1994. Forest canopy closure from classification and spectral unmixing: a multi-sensor evaluation of application to an open canopy, *IEEE Trans. on Geos. and Remote Sens.* 32(5): 1067-1080.

Gong, P., 1993. Change detection using principal component analysis and fuzzy set theory. *Canadian Journal of Remote Sensing*, 19(1):22-29.

Gong P. and P. J. Howarth, 1992. Frequency-based contextual classification and grey-level vector reduction for land-use identification. *Photogrametric Engineering and Remote Sensing*, 58(4):423-437.

Major Grants (from 8 grants currently held):

• Gong, P.	IHRMP Grant	Held	$165,000	1995-99
G. Biging	*Hardwood monitoring using an airborne digital camera integrated with INS and GPS*			
• Biging, G.	NASA	Held	$280,000	1997-99
Gong, P. others	*Center for Excellence for Remote Sensing Applications*			
• Biging, G.	USFS	Held	$350,000	1999-01
Gong, P.	*Test of digital photoecometrics as Forestry Inventory Tool*			
• Gong, P	National Science Foundation of China	Held	300,000 yuan	1999-02
	Any research use (via Institute of Remote Sensing Applications, CAS)			

Richard B. Standiford
Extension Forest Management Specialist
Associate Dean for Forestry

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Home: 2420 Temple Dr.
Davis, CA 95616
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Education:

BS, Forestry, 1976, North Carolina State University
MS, Wildland Resource Science (Silviculture), 1978, University of California, Berkeley
Thesis Title: "Predicting release of understory white fir in California following removal of overstory"
Ph.D., 1989, Agricultural Economics (Resource economics), Univ. of Calif., Davis
Dissertation Title: "A bioeconomic model of California's hardwood rangelands"

Awards, Honors, Professional Organizations:

University Salutatorian, North Carolina State University
Member of Xi Sigma Pi Forestry Honor Fraternity
1989 Dissertation of the Year Winner, American Assoc. of Agricultural Economists
Gaspar de Portola Catalonian Studies Program fellowship (in Catalonia 11/6 to 11/20, 1994)
Member of Society of American Foresters and Society for Range Management
California Registered Professional Forester #2015

Recent Grants

$20,000	From California Department of Forestry and Fire Protection -- Study of stand structure changes and oak stump sprouting in the Northern Sacramento Valley following firewood harvest
$10,000	From California Department of Forestry and Fire Protection -- Monitoring changes in hardwood rangelands in the southern Sierra Nevada
$15,000	From Univ. of California Division of Agriculture and Natural Resources -- Property value enhancement from adjacency to open space and oak stand density
$8,000	From the Sierra Nevada Ecosystem Project -- Assessment of oak woodlands in the Sierra Nevada region
$50,000	From Tulare County Assessor's Office -- Economic assessment of grazing land as a basis for property taxes

Work History:

University of California Cooperative Extension, Dept. of Environmental Science, Policy and Management (formerly Dept. of Forestry and Res. Mgt.):
Academic Appointments:

1980-1984	Assistant Specialist, Extension Forestry
1985- 1989	Associate Specialist, Extension Forestry
1989- present	Specialist, Extension Forestry

Responsible for developing a program focused on sound management of California's forests, rangelands, and other natural resources utilizing education, applied research, and a broad spectrum of working relationships. Provide leadership to county extension programs in development of forestry programs and conservation of oak woodlands. The clientele includes professional foresters and natural resource managers, private industrial and non-industrial forest owners and managers, rangeland owners and operators, timber operators, public and private forestry organizations, policy makers, and individuals concerned with natural resource management.

Administrative Appointments:

1) Program Director, Natural Resources, 1985-1987

First director of a group of 14 academic specialists in Cooperative Extension in forestry, wood products, wildlife, and range management. Responsible for obtaining state funding for five new permanent specialists in natural resources. Duties included personnel reviews, liaison with state and federal agencies and state legislature, budgeting, program planning and reporting, and coordination with research faculty and county staff. Also responsible for administration of federal Renewable Resources Extension Act funds.

2) Vice Chair-Extension, Dept. of Forestry & Resource Mgt., 1989- 1993

Responsible for coordination of all Cooperative Extension activities in the Department of Forestry and Resource Management following incorporation of extension into teaching and research departments. Duties include management of the statewide Integrated Hardwood Range Management Program, personnel reviews of 8 academic staff, budget administration, coordination with state and federal agencies, and program planning and reporting.

3) Program Manager- Integrated Hardwood Range Mgmt. Program, 1988- 1999

Coordinates all extension and research activities of the UC's Integrated Hardwood Range Management Program. This program is directed to the conservation of the state's hardwood rangeland resource through an aggressive outreach program and focused research.

4) Associate Dean for Forestry and Director, Center for Forestry; College of Natural Resources, 1998-present

General oversight over teaching, research and extension programs in forestry in the College of Natural Resources

Other Professional Positions:

1976, 1978 Assistant Forester, New Jersey Bureau of Forestry

Work as service forester giving technical assistance to non-industrial forest landowners, and administering cost share programs. Also work in statewide forest resource planning.

1978-1980 Forester, Purdue University

Position was 50% research in silviculture and forest management, and 50% Extension as area specialist in southwestern Indiana. Worked out of the Southern Indiana Purdue Agricultural Center and responsible for management of forestry operations on this 1500 acre research forest.

Current Research Areas:

Resource economics; natural resource management and decision-making; optimal control of forest and rangeland resources; short-rotation management of exotic hardwoods; bioeconomic modeling; hardwood management; sustained yield of hardwoods

Extension Areas:

Education of non-industrial private forest landowners; education of hardwood range owners; monitoring hardwood range lands; continuing education of professional foresters; use of microcomputers in natural resources; using forestry growth and yield models; home study correspondence course for forest landowners

John Radke
Associate Professor
Department of City and Regional Planning
Department of Landscape Architecture and Environmental Planning
Department of Geography
University of California, Berkeley

John Radke is internationally recognized for his contributions to pattern recognition, specifically his spatial decompositions that generate boundaries and formalize notions of neighborhood. His metrics, embedded within Geographic Information Science, compose spectrums which range from each element under study defining a neighborhood to all elements in the study set comprising one neighborhood. His metrics and methods characterize relationships, association and structure between objects, and have been successful in removing the often limited bias of absolute measurement by realizing new ways of comparing disparate distributions. He applies these methods to the field of Environmental Planning where he designs and constructs hazard models in attempts to predict and assess risk.

He speaks to and consults for local , regional and national governments on issues relating to Geographic Information Science, environmental monitoring, data mining and internet based software development. He has taught at Wilfrid Laurier University and the University of Pennsylvania. He lives in the Bay area with his wife and three children.

EDUCATION

1983 Ph.D. Geography, University of British Columbia, Vancouver, B.C.
1975 B.A. (Hons) Geography, Wilfrid Laurier University, Waterloo, Ontario
1977 M.A. Geography, Wilfrid Laurier University, Waterloo, Ontario

SELECTED EMPLOYMENT

* 1991-98 Associate and Assistant Professor, Department of City and Regional Planning, Department of Landscape Architecture and Environmental Planning, and Department of Geography, University of California, Berkeley
* 1995-97 Consultant , National Aeronautics Space Administration (NASA)
* 1985 –90 Research Assistant Professor, Department of Landscape Architecture and Regional Planning University of Pennsylvania, Philadelphia
* 1987 –90 GIS Director, Engineering, Computer Science & Architecture, Temple University, Philadelphia, PA
* 1983 –84 Visiting Professor, Department of Geography, Wilfrid Laurier University, Waterloo, Ontario
* 1984 –85 Information Scientist, AGRA Engineering Group Limited, Toronto, Ontario

SELECTED HONORS, FELLOWSHIPS, and AWARDS

1981-82 University Graduate Fellow, University of British Columbia
78-81 Doctoral Fellow, Social Science and Humanities Research Council (SSHRC), Canada

SELECTED RELEVANT PUBLICATIONS

* "Detecting Potential Erosion Threats to the Coastal Zone: St. John, USVI" *" International Journal of Marine Geodesy.* 1997, Vol 20, pp 235-254.
* " Boundary Generation for Dissagregate Point Data With Possible Applications to Ecological Classification" accepted, *GEOMATICA.*
* "A Strategy for Detecting Spatial Change in Landscapes in the Absence of Accurate Geo-positioning" is in review at: *Landscape and Urban Planning.*
* "Spatial Decompositions and Detecting the Bounding Hull of a Set of Points" accepted with minor revisions by: *The Canadian Geographer*.
* "A Spatial Decision Support System (SDSS) to Aid The Vegetation Management Plan in the East Bay Hills", *ESRI Map Book*, 1995, Vol. 10, p 46.
* "A Spatial Decision Support System for Urban/Wildland Interface Fire Hazards", *Proceedings of the 15th Annual ESRI User Conference*, 1995.
* "Modeling Urban/Wildland Interface Fire Hazards within a Geographic Information System" in *Geographic Information Sciences*, 1995, Vol.1, No.1, pp7-20.
* "History of the Human Ecology of the Delaware Estuary", with Jon Berger and John Sinton, a report for the Delaware River Basin Commission (peer reviewed and accepted), February 1994..

RECENT INVITED LECTURES

* " Enhancing The Application Of The Revised Universal Soil Loss Equation (RUSLE) Through The Use Of A Digital Terrain Model (DTM)", *CPGIS Informatics '96,* West Palm Beach, Florida, April 27, 1996.
* "NASA's Mission: Workforce 2005", Invited Discussant, Charlotte, North Carolina, April 12, 1996.
* " The role of the World Wide Web and HTML in delivering GIS in Higher Education", *Association of American Geographers 92nd Annual Meeting*, Charlotte, North Carolina, April 10, 1996.
* "University Consortium for Geographic Information Science (UCGIS): a Draft Brochure", with A. Calkins, *GIS/LIS '95* , November 14, 1995.
* "A Report on Spatial Information Infrastructure in the City of Berkeley", Information Systems Group, *City of Berkeley*, with Bruce Appleyard, August, 1995.
* "The Integration of Geographic Information Systems, Global Positioning Systems and Remote Sensing in Developing Fire Risk Models ", Invited Lecture, Department of Landscape Architecture and Environmental Technology, Universitas Trisakti, Jakarta, Indonesia, June 6, 1995.
* "Predicting Potential Fire Risk on the Urban Fringe using Geographic Information Systems", Invited Speaker, *Beijing Urban GIS Workshop*, Institute of Remote Sensing and GIS, Peking University and CPGIS, Beijing, China, June 4, 1995.
* "An Alternate Approach To Emergency Response: The Use Of GIS To Plan And Manage Strategies For Fighting Fires In The Eastbay Hills", Invited Lecture, *Bay Area Automated Mapping Association (BAAMA),* October 19, 1994.
* "Towards a National Emergency Management Information System", Invited Lecture, *Lawrence Livermore National Laboratory*, August 26, 1994.

Pu, Ruiliang

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Ruiliang Pu is a research associate in the Department of Environmental Science, Policy, and Management, The University of California at Berkeley. Before 1990, he was a lecturer in the Department of Forestry, Nanjing Forestry University. He was a visiting scholar between 1990-1991 in the Earth-Observations Laboratory, Institute for Space and Terrestrial Science, Ontario, Canada. Since 1993, he has been an associate professor of Department of Forestry, Nanjing Forestry University. He was a visiting scholar in the Department of Geomatics Engineering, The University of Calgary, Canada, in 1994. He has been awarded prizes three times for achievements in sciences and technology by the Chinese government between 1986 to 1991. He is author/coauthor of over 30 technical papers. His research interests include application of remote sensing and GIS technologies in evaluating productivity of forest land and ecosystem modeling, extracting forest canopy structure parameters and ecosystem classification with an emphasis on the use of hyperspectral data, digital CCD camera imagery, and neural network techniques.

EDUCATION

1999 PhD, (expected) Institute for Remote Sensing Application, Chinese Academy of Sciences, China
1985 M.Sc., Forest Management, Remote Sensing in Forestry, Nanjing Forestry University (NFU), Nanjing, China.
1982 B.Sc., Forestry, NFU, China.

EMPLOYMENT

Teaching

1993-1994 Associate Professor, Department of Forestry, NFU, Nanjing, China
Courses taught:
- Remote sensing in forest resources for graduate and undergraduate students
- Forest resource management for undergraduate students

1985-1992 Assistant Professor, Department of Forestry, NFU, Nanjing, China
Courses taught:
- Remote sensing in forest resource for undergraduate students
- Forest management for undergraduate students
- Forest mensuration for undergraduate students

Research

1995- Staff Research Associate, Department of Environmental Science, Policy, and Management, The University of California at Berkeley, California, U.S.A.
1994-1995 Visiting Research Scientist, Department of Geomatics Engineering, The University of Calgary, Canada.
1992-1994 Associate Professor, Remote Sensing Laboratory, NFU, Nanjing, China
1990-1992 Visiting Research Scientist, Earth-Observations Laboratory, ISTS, North York, Ontario, Canada.
1985-1990 Assistant Professor, Remote Sensing Laboratory, NFU, Nanjing, China

ACADEMIC AND PROFESSIONAL INTERESTS

Remote Sensing Image Analysis and Application

- Imaging spectrometer data analysis to forest ecosystem
- Forest resource inventory, estimation and forecasting
- Forest resources change monitoring
- Forest type and site-type mapping

Geographic Information System Analysis and Application

- Landscape dynamic planning
- Wildland fire simulation
- Wildlife habitat classification

Quantitative and Computer Analysis Technologies

- Multivariate analysis
- Quantitative site-index tabulating
- Neural network analysis in ecosystem
- Computer programming in C/FORTRAN
- Environmental protection

AWARDS

1991	Prize of Science Technology, second place, by The Ministry of Forestry of China
1991	The best scientific paper from The Association of Remote Sensing in Jiangsu Province, China
1987	Prize of Science Technology, second place, by Jiangsu Province, China
1988	Prize of Science Technology, third place, by The Ministry of Forestry of China.

PUBLICATIONS

10 selected publications (from 24 refereed articles)

Pu, R., and P. Gong, 1998. Modeling land-cover changes with gray systems theory and multitemporal aerial photographs, *Geographic Information Sciences*, 4(1-2): 74-79.

Gong, P., R. Pu, and B. Yu, 1998, Conifer species recognition with seasonal hyperspectral data, *Journal of Remote Sensing*, China, 2(3):211-217.

Gong, P., R. Pu, and B. Yu, 1997, Conifer species recognition: an exploratory analysis of *in situ* hyperspectral data, *Remote Sens. Environ.*, 62:189-200.

Pu, R. and P. Gong, 1997, Relationships between forest biochmical concentrations and CASI data along the Oregon Transect, *Journal of Remote Sensing*, China, 1(2):115-123.

Gong P., R. Pu, J. Chen, 1996, Mapping ecological land systems and classification uncertainties from digital elevation and forest-cover data using neural networks, *P. E. & R. S.*, 62(11):1249-1260.

Gong, P., P. Shi, R. Pu, and H. Guo, 1996, *Earth Observation Techniques and Earth System Science*, (a book) Science Press, Beijing, China.

Gong, P., Pu, R., and Miller, J. R., 1995, Coniferous forest leaf area index estimation along the Oregon Transect using Compact Airborne Spectrographic Imager data, *P. E. & R. S.*, 61(9):1107-1117.

Pu, R., Gong, P., and Miller, J. R., 1993, Spectral Derivative Analysis For Ponderosa Pine Leaf Area Index Estimation, *Remote Sensing of Environment*, China, 8(2):112-125.

Pu, R. and Fang, Y., 1992, Application of remote sensing techniques to forest site survey, *Geocarto International*, 7(3):19-24.

Pu, R. and Miller, J. R. 1991, Classification and evaluation of a shelter forest site in a coastal area using remote sensing techniques, *Canadian J. of R. S.*, 17(4):323-331.

Susan A. Mahler

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EDUCATION

University of California at Berkeley 8/97 to Present
Graduate Student, ESPM, Ecosystem Science Division, Remote Sensing Emphasis, graduation May 1999

University of California at Berkeley B.A. Earth Science, 1992
Colorado Northwestern College A.A.S. Aviation Technology, 1987

PROFESSIONAL EXPERIENCE

Sky Works **5/87 to present**
FAA Certified Flight Instructor. Provided flight and ground instruction for students seeking private, commercial, instrument and flight instructor licenses/ratings.

Sky Works **10/96 to 6/97**
Consultant. Primary contract from 10/96 through 10/97 was with Terra Spase, a start-up vineyard consulting firm. Directed the creation, development, proccesing, production, marketing and sales of remote sensing and GIS products for vineyard and winery customers. Developed processes to integrate a variety of spatial data existing in incompatible formats. Acted as primary technical and marketing contact for clients. Managed relationships for a collaberative NASA/industry project that included research in the utilization of ADAR imagery in vineyards. The project was successful and profitable in the first year, and served 40 new vineyard and winery clients.

Other contracts have included image analysis for a winery vineyard acquisition project, and a vineyard mapping project.

Lawrence Berkeley National Laboratory **6/93 to 6/97**
Senior Research Associate. Research included spatially dissagregated economic and statistical modeling and forecasting of national energy efficiency standards. Database development and programming. Responsibilities included the development of a working GIS laboratory for our program including purchasing, initializing and managing GIS-related software on a Sun Sparc 20 workstation including Arc/Info and ArcView. Assist in the general system administration of the Sparc 20. Managing GIS projects for the Forecasting and Energy Conservation Policy Groups. Consulting other groups interested in beginning GIS projects and managing GIS resources for these users.

University of California at Berkeley **10/91 to 5/93**
Lab and Field Assistant. Studied ecological effects of climate change as related to nutrient and gas cycling in soils with Dr. John Harte. Work included collection and analysis of soil, vegetation and air samples using a gas chromatograph and mass spectrometer in California and at the Rocky Mountain Biological Lab in Colorado.

International Rivers Network **10/92 to 3/93**
Research Assistant. Internship with a non-profit organization that advocates the preservation of the world's rivers and watersheds. Researched and authored a briefing paper concerning renewable energy resources, and energy conservation as alternatives to large-scale hydroelectric projects.

Washington University **6/92 to 8/92**
Research Assistant. NASA Planetary Geology and Geophysics Undergraduate Research Program (PGGURP). Researched the cratering processes and sedimentation cycle of the planet Venus using the latest remote sensing information from the Magellon Mission Satellite.